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THE BEGINNINGS OF THE ACADEMIC CAREER OF ȘTEFAN PROCOPIU

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Physicist Ștefan Procopiu (1890–1972) represents one of the most prominent personalities in the science and education of Romania, his name being related to fundamental discoveries in the scientific world, namely: determination of the molecular magnetic moment (1912); the Procopiu phenomenon (a process consisting in the longitudinal depolarization of the colloidal solutions and crystalline suspensions) and the Procopiu effect (resulting from the study of the Barkhausen effect, which involves passage of an alternating current through wires made of a ferromagnetic material, finally leading to the discovery of the circular effect of magnetic discontinuity).

Commemoration of the 50 years since his passing away recalls feelings of profound respect and intellectual consideration for the distinguished scientist of Iasi – reputed professor, educator and researcher, with decisive innovative reverberations in the Romanian and international academic space.

Ștefan Procopiu was born on January 19, 1890, in Bârlad, a town of intellectual elites, best represented, in the end of the 19th century, by the writer Alexandru Vlahuță, the painter Nicolae Tonitza, the poet George Tutoveanu, the mathematician Ion Plăcințeanu and some others.

Graduate and valedictorian of the "Roșca Codreanu" High School in his hometown, he applied, in 1908, at the Faculty of Sciences of Iași.

The plenary formation of such a complex personality is, to a considerable extent, the result of the education offered by prestigious professors, trained in reputed European schools, whom the young student had the chance of meeting during his university years at the Faculty of Sciences in Iași.

On this occasion, he attended the courses delievered by Professor Dragomir Hurmuzescu, a pioneer in modern physics, holder of a bachelor's and a PhD degree under the guidance of Gabriel Lippmann, a Nobel Laureate in 1908 [1].

After graduating the Faculty of Sciences, in 1912, Procopiu started publishing articles in specialized journals [2], among which mention should be made of the following titles:

- *Variation de la force électromotrice par le mouvement de l'électrolyte,* Scientific Annals, University of Iași, 7, 1912, pp. 224–234.
- *Sur les éléments d'énergie,* Scientific Annals, University of Iași, 7, 1912, pp. 280–290.
- *Moment magnétique moléculaire par la théorie des quanta de Plan,* Scientific Bulletin, Romanian Academy, 1, 1913, pp. 151–157.
- *La sensibilité et la résistance des détecteurs à contacts imparfaits dans la T.S.F,* Scientific Bulletin, Romanian Academy, 2, 1913, pp. 129–134.
- *Force électromotrice due au déplacement relatif d'une électrode et d'un électrolyte,* Scientific Bulletin, Romanian Academy, 3, 1915, pp. 187–198 [3].

Between 1913 and 1919, he worked as a substitute assistant in the Laboratory of Electricity Applications at the University of Bucharest, and then, following Dragomir Hurmuzescu to Iași, he became substitute head of works – between 1919 and 1924.

After obtaining the title of Doctor in Physical Sciences at the University of Paris on March 5, 1924, with the thesis entitled "On the electrical and magnetic birefringence of suspensions", starting with January 15, 1924 (decision number 271) Procopiu became full professor in the Department of Gravity, Heat and Electricity at the Faculty of Sciences in Iasi.

Here, the talented researcher and eminent professor he was to become worked uninterruptedly until his retirement in 1962.

Ștefan Procopiu was assisted by Vasile Petrescu (until March 1, 1932) and Gheorghe Vasiliu (until March 1, 1935) as heads of works, he collaborated with assistants Gheorghe Vasiliu (until February 29, 1932), Virgil Gheorghiu (March 1, 1932 – December 31, 1934), Alexandru Neculai Florescu (since May 1, 1933). His teaching assistants were: Virgil Gheorghiu (until February 29, 1932), Neculai Calinicenco (from September 1, 1932) and Virginia Procopiu (from June 1, 1935) [3].

Along the years, he delievered several courses of Electricity and Thermodynamics (1948).

In the following, we shall present one of the experiments performed by Ștefan Procopiu in the Electricity class on March 2, 1946, referring to the properties of a three-electrode lamp in alternating current.

The grid of a three-electrode lamp has the property of stopping the current flowing between the positively charged plate and the incandescent filament placed at the negative pole of a battery pack. When the grid is charged with electricity by approaching an ebonite stick, negatively charged by friction, the grid prevents the current from passing through a galvanometer on the circuit board. The galvanometer immediately goes to zero.

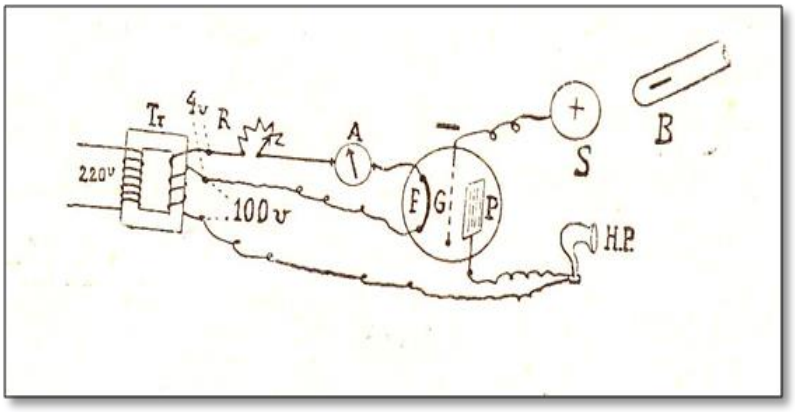

Figure 1. The electrical circuit proposed by Ștefan Procopiu.

After returning from the refuge imposed by the war, as the Electricity Laboratory had no longer any source of direct current, Professor Procopiu attempted at performing the previously mentioned experiment in alternating current, finding out that, with an alternating current, the result obtained was even more impressive. The experiment was performed as illustrated in Figure 1: plate P of the lamp is connected to an alternative potential of one hundred volts, the other pole of the alternating current being connected to the incandescent filament. On the circuit board, there is also a loudspeaker or a telephone that always produces a sound. As we move the negative electrified stick closer to the S-sphere, which is connected to the G-grid of the lamp, the phone stops. The influence of the electrified stick is felt, on dry days, even from a distance of 2 meters. With a powerful three-electrode lamp, the phone could be replaced with a small incandescent lamp, which would go out when we put the electrified stick close to the grid.

Interested in evidencing the electric waves occurring during small sparks produced by a Wimshurst electrostatic machine, Procopiu presented a new experiment he had performed, more precisely he connected the machine conductors to a galvanometer or an amplifier equipped with lamps.

When the machine operates, the phone on the amplifier makes a sound whose frequency depends on the speed of machine's discs, that is the number of tin sectors on the discs that pass in front of machine's brushes and from which electricity is discharged as small sparks otherwise invisible.

With the same, only slightly modified experiment, Professor Procopiu highlighted the electric waves by placing a T.F.S. amplifier nearby, at a distance of 10 meters, with no connection to the electrostatic machine. At its input, the amplifier was provided with a coil with about 4,000 turns, the same number being used in the study of Barkhausen magnetic phenomenon, and shown in Figure 2.

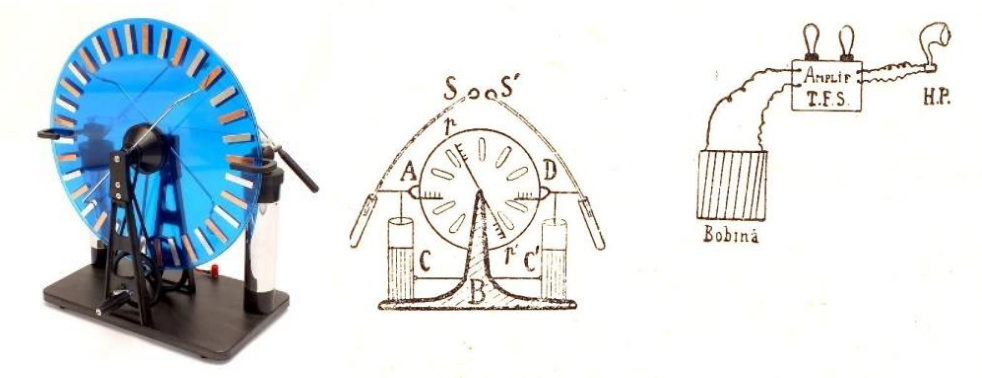

Figure 2. Highlighting electric waves on a Wimshurst machine.

He observed that "the amplifier records the sparks that appear on the brushes, as well as the sparks between the spheres of the two lead wires of the machine". Moreover, if the machine has stopped working, and if the spheres of the two lead wires are brought into contact, "the residual sparks due to the two Leyda bottles of the machine, which are discharged through the insulating pellicle between the spheres, are heard on the amplifier. In the dark, these residual discharges cannot be seen, but the amplifier highlights them. Successive residual sparks appear in geometric progression over time and sometimes last for several hours" [4].

Professor Procopiu delievered a series of scientific conferences, among which mention should be made of: *Chimeras of Science* on the occasion of the opening of the academic year 1933–1934 (published in the Scientific Journal "Vasile Adamachi in 1933, volume 19, pp. 131–140), *The Constitution of the Atom, Neutron, Positron, Artificial Radioactivity* ("Vasile Adamachi" Scientific Journal, 1935, volume 21, pp. 156–173), *Criteria for the idea of progress* (Minerva, Iași, 1931, no. 1), *What is electricity*? (vol. XXVII, nr. 1, 1941, pp. 238) [6].

Worth remembering are also the two experiments carried out by Professor Procopiu to demonstrate the particles emitted in artificial radioactivity by the method of the number of electrons of Geiger and Müller, a process based on the ionization of gases crossed by the investigated radiations. If the gas is located between two metal plates placed at a potential difference smaller than that required for a disruptive discharge, the ionizing particle can initiate this process, especially if a sharp peak is placed on one of the electrodes, and not on the plate.

An electrostatic machine is connected to a Leyda bottle battery, from which it is separated by a certain distance, to avoid discharging through it. The two armatures of the capacitor bank are connected as follows: the positive one with the tube, and the negative one with the help of a resistor R, with the tip, the rest as illustrated in Figure 3 [5].

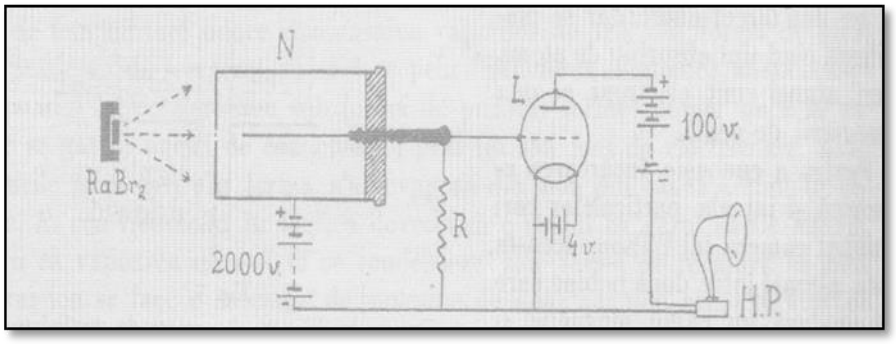

Figure 3. The peak counter connected to a T.F.S. amplifier and a loudspeaker.
The tip is connected to the grid of a three-electron lamp.

The radioactive substance, placed in front of the hole of the counter, emits alpha or beta particles, or a beam of electrons, such as a zinc plate irradiated with ultraviolet rays under whose action photoelectrons are emitted. Every electron that enters the hole makes the speaker produce a sound. The experiment is considered to be one of the most impressive one in physics, because every particle entering the counter can be heard on the phone.

The second experiment carried out by Professor Procopiu involves a small number of particles that reach a large surface, such as cosmic rays or positrons. Thus, a tube about 20 cm long has insulating ebonite plugs at both ends, through its axis passing a thin iron wire with an insulating layer on it. The tube is connected to the negative pole of a 1.200 V battery. The rest of the connections are the same as for the peak counter (Fig. 4).

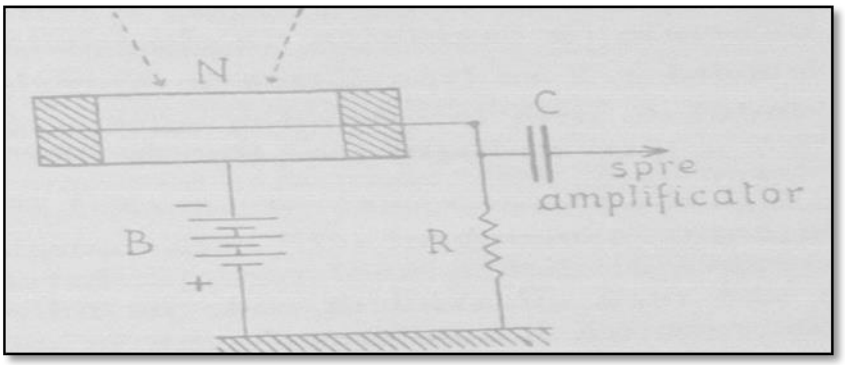

Figure 4. Geiger and Müller's electron counting tube. N – counter through whose axis passes a wire of oxidized iron, connected to the grid of a three-electron lamp by means of the C capacity. Radiation penetrates through the walls of the N cylinder or through the windows fitted into the walls.

By moving ions or ionizing particles from the tube covered with a thin sheet of celluloid, an ionization process occurs, producing a current. This counter is more sensitive than the peak counter because it measures the volume effect. It is used in the study of cosmic rays. Geiger's counter measures only the discharges produced by particles, without distinguishing each particle.

In the popular "V. Adamachi" Science Journal, whose collaborator Procopiu has been for a long time, he published valuable articles offering original information, such as: *Julius Robert Mayer. One hundred years since the discovery of the principle of energy conservation* (published in vol. XXVIII, No. 4 of 1942, pp. 225–239), *The enigma of earthly magnetism* (vol. XXXIV, no. 1–2, 1948, p. 55–61), notes and information: *Sunspots and their influence on earth phenomena* (vol. XXXIII, no. 1, 1947), brief original papers: *Contributions to the theory of birefringence and dichroism of colloidal liquids and crystalline suspensions subject to an electric or magnetic field* (vol. XXIX, 1943, pp.165–167), etc.

In 1930, he published the first volume entitled *Introduction to Electricity and Magnetism* (328 pages), issued by the House of Schools Publishing House [6].

For over 50 years, Ștefan Procopiu developed and published over 170 scientific studies mainly devoted to electricity, magnetism, optics and heat.

In time, he was elected member of some prestigious scientific national and international societies, such as: the Romanian Physics Society, Société française d'Astronomie, Société française de Physique, the National Geophysics Committee of the Romanian Academy, etc.

His passion for literature, music, philosophy and interest in the physical-mechanical field explains his friendship with the poet and writer George Topîrceanu, the composer George Enescu, the chemist C.V. Gheorghiu and with great historians and law professors of Iași.

Among the notes of professor C.V. Gheorghiu, those related to the scientific personality of Professor Procopiu are particularly interesting*: I got to know Professor Procopiu better, after I took over the management of "V. Adamachi" Journal, in 1940. He was passionate about the science he practised and he often continued his discussions started at the University in the street, forgetting to go to dinner… Ştefan Procopiu carried out an important activity in the field of science, publishing numerous works, which until 1941 exceeded the number of 100.*

He discovered the phenomenon of electromotive force of motion, established a new method for the study of electrolyte dispersion and thermal conductivity, studied the electrical and magnetic birefringence of crystalline suspensions, called in literature the Procopiu phenomenon, studied the transversal "Barkhausen phenomenon", and produced the first magnetic maps of Romania [7].

He published over 80 scientific articles in specialized journals, among which: *Scientific Annals of the University of Iași, Scientific Bulletin of the Romanian Academy, Revue générale de l'Électricité (Paris), Annalles de Physique (Paris), Bulletin of the Romanian Society of Sciences, Société française de Physique,*

Journal de Physique, Physik Zeitschrift, Radiofonia, Journal de Chimie Physique, Zeitschrift für Physik, Chemistry, Terrestrial magnetism.

Ștefan Procopiu wrote 4 specialized books: *Perpetuum mobile and the principles of energy* (Bucharest, 1919, 182 pages), *Introduction to electricity and magnetism* (Vol. 1, Iași, 1929, 328 pages), *Electricity and magnetism* (vol. II, Iași, 1939, 336 pages), *What is electricity?* (Romanian Energy Institute, No. 212, Bucharest, 1940, 23 pages).

For his special merits in education and science, he was awarded the titles of Emeritus Scientist and *Doctor Honoris Causa* of the "Gheorghe Asachi" Polytechnic Institute in Iași.

As early as his life, Ștefan Procopiu became the only Romanian scientist mentioned in the reference work devoted to prominent personalities, "Who's Who", published annually in Great Britain since 1849 [8].

The academician died on August 22, 1972 and was buried at Eternitatea cemetery in Iași. His memory is permanently honoured at the Museum of Science and Technique in Iaşi, which, in the year 1994, received his name.

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